HEAT SINK WITH INTEGRAL CARD GUIDE

FIELD OF THE INVENTION

The present invention generally relates to a heat sink for dissipating heat from electronic components and more particularly relates to a heat sink having one or more recesses for guiding circuit cards.

BACKGROUND OF THE INVENTION

Electronic systems demand increasingly higher performance in increasingly smaller space and at an increasingly smaller cost. The current trend in electronic systems is to reduce the overall size, cost and complexity of components to meet these requirements. Heat sinks are commonly used in such electronic systems to dissipate heat from a heat-generating component, such as an ASIC device. The heat transfer capability of heat sinks, however, depends upon their size, substantially limiting effective reduction of their size.

Card guides are commonly used to carry and support an edge of a circuit card to align it with a connector and/or to maintain spacing from other components of an electronic system, for example. Exemplary card guides have sufficient structural strength to gather, guide, and/or retain a circuit card. This structural requirement can substantially limit effective size reduction of the card guide.

SUMMARY OF THE INVENTION

The present invention, in one aspect, provides a heat sink configured to support an edge of a circuit card. The heat sink comprises a

thermally conductive base, a plurality of thermally conductive heat dissipating fins extending from the base, and one or more recesses at least partially defined by at least one of the fins or by the base. The recesses are configured to support the edge of the circuit card.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is best understood from the following detailed description when read in connection with the accompanying drawings. It is emphasized that, according to common practice, the various features of the drawings are not to scale. On the contrary, the dimensions of the various features may be arbitrarily expanded or reduced for clarity. Included in the drawings are the following figures:

Figure 1 is an isometric view of an exemplary heat sink with recesses for guiding a circuit card according to aspects of the present invention;

Figure 2 is an isometric view, partially in section, of an exemplary electronic system having a heat sink with recesses for guiding a circuit card according to aspects of the present invention;

Figure 3 is an isometric view of a circuit card and a heat sink in accordance with an exemplary embodiment of the present invention; and

Figure 4 is a flow diagram illustrating a method of supporting a circuit card in a computer system in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings generally, the present invention, in one aspect, provides a heat sink 10 configured to support an edge of a circuit card 20. The heat sink 10 comprises a thermally conductive base 12, a

plurality of thermally conductive heat dissipating fins 14 extending from the base 12, and one or more recesses 16 at least partially defined by at least one of the fins 14 or by the base 12. The recesses 16 are configured to support the edge of the circuit card 20.

Referring now to the drawings, in which like reference numbers refer to like elements throughout, Figure 1 shows an exemplary heat sink 10 for dissipating heat from heat-generating component 4 (e.g., a semiconductor chip) and guiding a circuit card 20 according to aspects of the present invention. Heat sink 10 comprises a base 12, fins 14 extending from base 12, and one or more recesses 16 defined by the base 12 and/or one or more of the fins 14. Base 12 comprises a thermally conductive material, such as aluminum. As shown in Figure 1, base 12 may have a face configured to abut a heat-generating component 4. Thus, heat sink 10 provides a thermal path from heat-generating component 4 to fins 14 by thermal conduction to dissipate heat generated by heat-generating component 4.

Fins 14 extend from base 12 to a height D14 appropriate for dissipating the heat generated by heat-generating component 4. Fins 14 are generally parallel and are spaced apart to form gaps between adjacent fins so that heat can dissipate into air surrounding fins 14 by convection. Airflow 2 may be provided parallel to fins 14 to facilitate heat dissipation. Fins 14 comprise a thermally conductive material, for example, aluminum. Further, as shown in Figure 1, fins 14 and base 12 are optionally integrally formed with one another. In an exemplary embodiment of the present invention, heat sink 10 may be formed from a single extrusion.

One or more recesses 16 are formed in heat sink 10 to carry an edge of a circuit card 20. Recesses 16 may be defined by base 12, by one or more fins 14 or fin portions (as shown in Figure 1), or by a combination of base 12 and one or more fins 14. In an exemplary embodiment, recesses 16 are slots or grooves configured to carry the edge of circuit card 20 in sliding association with heat sink 10. Each of the one or more recesses 16 has a width W16 sufficient to receive the edge of circuit card 20 and to provide support to hold circuit card 20 in alignment with a

corresponding one of recesses 16. Each of the one or more recesses 16 has a depth D16 sufficient to support circuit card 20 without interfering with components (not shown) mounted on circuit card 20.

In the exemplary embodiment of the present invention shown in Figure 2, heat generating component 4 is mounted on a circuit board 6 in an electronic assembly. Heat sink 10 is mounted in abutting contact with heat generating component 4, and may be affixed to circuit board 6 for structural stability. A connector 8 is provided in the electronic assembly to mate with circuit card 20. Optionally, airflow 2 may be generated to facilitate heat dissipation from heat sink 10.

Circuit card 20 may be hot exchangeable, meaning that it can be mated and de-mated with connector 8 while the electronic assembly is operating. Due to high packaging density, an exemplary electronic assembly may not provide adequate space to guide circuit card 20 into connector 8 by hand. Circuit card 20, for example, may be one of a plurality of circuit cards mounted parallel to one another and closely spaced to one another in an electronic system. Also, when hot exchange of circuit card 20 is performed, it is necessary to maintain clearance between circuit card 20 and adjacent electronics.

Accordingly, heat sink 10 is used to guide circuit card 20 into place by positioning a leading corner or edge portion of circuit card 20 in a corresponding one of the one or more recesses 16, while circuit card 20 extends away from heat sink 10, where it is more accessible for handling and manipulation. Then, circuit card 20 is advanced into its operating position by sliding an edge of circuit card 20 along a corresponding one of the one or more recesses 16. While circuit card 20 is advanced, the corresponding one of recesses 16 guide and support circuit card 20, facilitating mating circuit card 20 with connector 8. After circuit card 20 is mated to connector 8, the corresponding one of the one or more recesses 16 continues to support circuit card 20.

As shown in Figure 2, mounting hardware 9 may be provided on circuit card 20 opposite heat sink 10 to secure circuit card 20 to the

chassis or frame (not shown). Optionally, circuit card 20 is oriented generally parallel to airflow 2 to optimize heat dissipation both from heat sink 10 and from components (not shown) mounted on circuit card 20.

In an alternative exemplary embodiment of the present invention, heat sink 20 dissipates heat from a heat-generating component (not shown) mounted on circuit card 20 guided by heat sink 10. A thermal path from such component to heat sink 10 may be provided, for example, by a conductive spring or the like affixed in an abutting relationship with one of the mounted heat generating component and heat sink 10 and in sliding association with the other of the mounted heat generating component and heat sink 10. Alternatively, a conductive path is provided from the component, through or along the circuit card 20, and to the surface of the heat sink 10 defining the recess 16.

Although Figures 1-2 have primarily been described with respect to circuit boards including an edge portion that is slidingly engaged within a recess defined by the base and/or fins of a heat sink, the present invention is not limited thereto. Figure 3 illustrates a circuit board 30 (e.g., a PCI card) having an edge portion engaged with a recess defined by heat sink 10. For example, the edge portion of circuit board 30 is engaged with the recess from above the heat sink, and not by being slid along the recess. Such a configuration may be particularly useful if the computer system defines an opening making a recess defined by heat sink 10 more accessible from above, and not from a slidingly engagable position.

Additionally, circuit board 30 includes mating portion 30a. Mating portion 30a is configured for engagement with a connector of the computer system (not shown). For example, mating portion 30a may include contacts (e.g., socket connector fingers not shown in Figure 3) configured for engagement with corresponding connection points in the connector of the computer system. Because the edge portion of circuit board 30 that engages with a recess defined by heat sink 10 is along the same edge of circuit board 30 as mating portion 30a, it may be difficult (or even non-feasible) to slidingly engage the edge of circuit board 30 within

the recess. As such, the edge portion of circuit board 30 is desirably engaged with the recess defined by heat sink 10 from above (and not by sliding engagement).

Further still, the computer system or electronic apparatus housing circuit board 30 may be configured such that while the edge portion engages with the recess defined by heat sink 10, mating portion 30a simultaneously engages with a respective connector(s). Such a configuration would help to ensure proper alignment of circuit board 30, because both the edge portion (engaging with a recess defined by heat sink 10) and mating portion 30a (engaging with a connector) have previously defined and distinct points of engagement within the computer system or electronic apparatus.

Figure 4 illustrates a method of supporting a circuit card within a computer system or electronic apparatus. At step 402, a heat sink is affixed in a computer system or other electronic apparatus. The heat sink defines a recess configured to receive an edge of a circuit card. At step 402, the heat sink is oriented such that the recess is positioned to receive an edge of a circuit card. At step 404, the edge of the circuit card is positioned, at least partially, in the recess defined by the heat sink. At optional step 406, the edge of the circuit card is slid in the recess defined by the heat sink.

Although the invention is illustrated and described herein with reference to specific embodiments, the invention is not intended to be limited to the details shown. Rather, various modifications may be made in the details within the scope and range of equivalents of the claims and without departing from the invention. For example, while the heat sink may comprise aluminum, other materials with good thermal conductivity may be used. This material may be electrically insulating and thermally conductive in applications where an electrically conductive path is undesirable.

Additionally, while the recesses defined by the base and/or fins of the heat sink have been illustrated and described as being primarily

parallel with respect to one another, they are not limited thereto. For example, the recesses (and the fins of the heat sink) may be oriented perpendicularly with respect to one another, or may be oriented at any of a number of angles with respect to one another. Further, the recesses (and the fins of the heat sink) may be oriented in a radial configuration.

Further still, the heat sink described herein has wide application in computer systems and other electronic apparatuses. The heat sink may provide support and/or act as a guide for any of a number of computer cards, circuit boards, or other computer components, thereby reducing the space required for the computer system and concurrently providing the desired heat dissipation.

Also, while the slots in a heat sink may be configured to receive a circuit card in a sliding relationship to guide the circuit card into place, the slots may alternatively be keyed to receive an edge of the circuit card in a specific position.

A recess may be defined in the end of a fin, the side of a fin, between fins, or in the base. One recess may be provided in a heat sink, or multiple recesses may be provided either for receiving multiple circuit cards or for offering multiple positions for a circuit card. The recesses may be rectangular in shape or rounded at the bottom or otherwise shaped. Additionally, recesses may be continuous over the length of the heat sink or non-continuous structures at one or more locations along the length of the heat sink.

While preferred embodiments of the invention have been shown and described herein, it will be understood that such embodiments are provided by way of example only. Numerous variations, changes and substitutions will occur to those skilled in the art without departing from the spirit of the invention. Accordingly, it is intended that the appended claims cover all such variations as fall within the spirit and scope of the invention.